

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property
Organization
International Bureau



(43) International Publication Date
21 May 2004 (21.05.2004)

PCT

(10) International Publication Number
WO 2004/042679 A1

(51) International Patent Classification⁷: **G09F 9/305**

(21) International Application Number:
PCT/GB2003/004770

(22) International Filing Date:
5 November 2003 (05.11.2003)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
0225773.1 5 November 2002 (05.11.2002) GB

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(81) Designated States (*national*): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

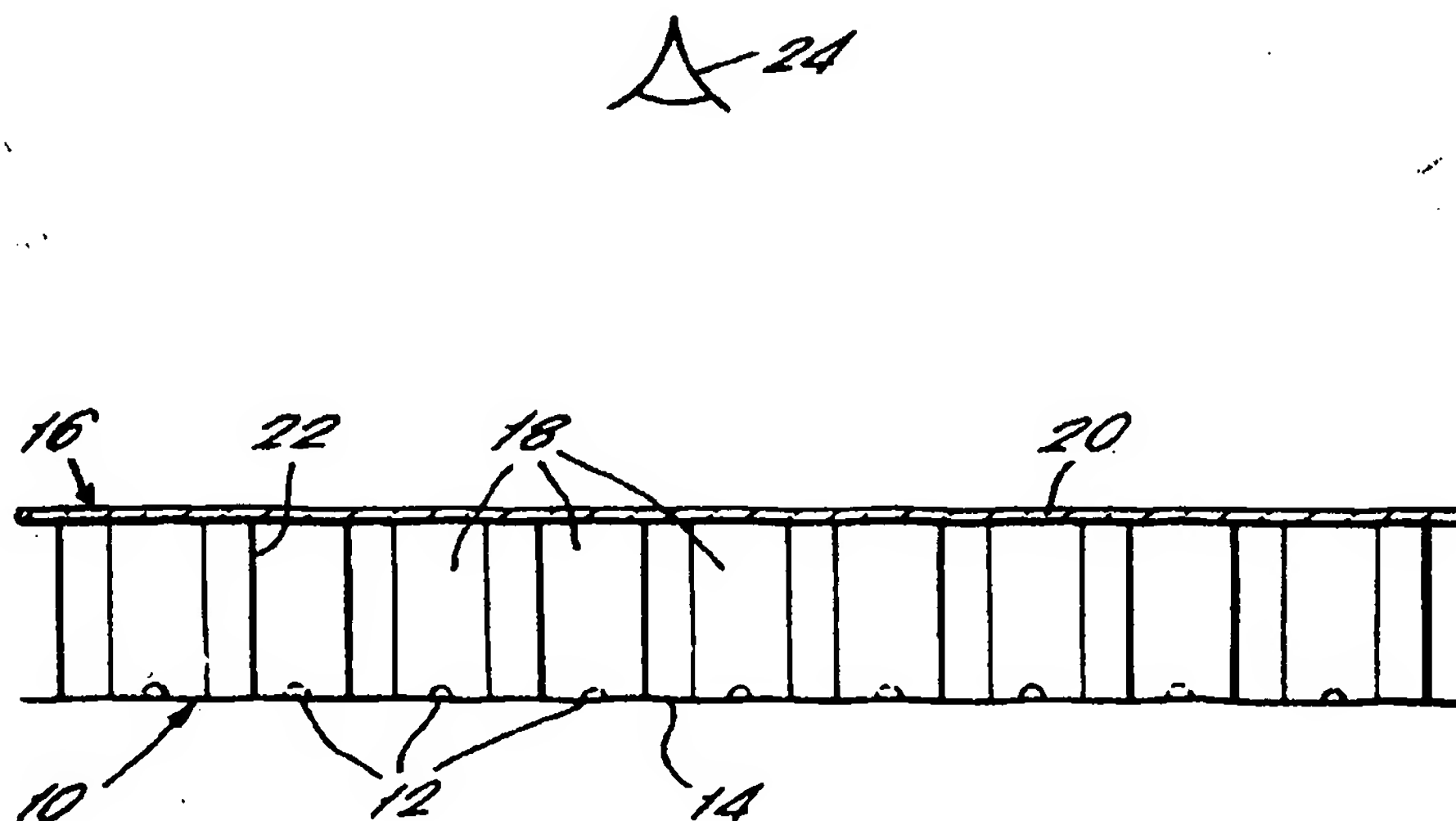
(84) Designated States (*regional*): ARIPO patent (BW, GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Declaration under Rule 4.17:

— of inventorship (Rule 4.17(iv)) for US only

[Continued on next page]

(54) Title: **DISPLAY SYSTEM COVER**



(57) Abstract: An assembly (16) for covering a visual display means (10) which has an array of pixels (12) is described. The assembly (16) comprises an array of cells (18) with reflective walls and an opening at each end. A transparent cover sheet (20) is positioned adjacent the open end of the cells (18) on one side of the array. The array is dimensioned such as in use each cell (18) is aligned with one pixel (12) of the visual display means (10). In this way, large visual display systems with excellent optical performance can be provided which can be used both internally and externally and are capable of bearing loads and forming structural members.

WO 2004/042679 A1



Published:

— *with international search report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

DISPLAY SYSTEM COVER

The present invention relates to an assembly for
5 covering a visual display system which improves the optical
and physical performance of the system.

It is known to provide visual displays made up of an
array of pixels, with each pixel being created by a light
10 source such as an LED or the end face of an optical fibre.
Such visual displays can be used for informational signage,
advertising, relaying TV pictures, art installations and so
on. However, such displays suffer from a number of
disadvantages. The angle at which the screen can be viewed
15 and the distance from which it can be viewed in order to see
a reasonably coherent and legible image are relatively
limited. The optical performance and legibility even when
viewed within the preferred ranges is not particularly great
since the image tends to appear as dots of colour on a black
20 background. The visual displays require additional
modification, at great expense, in order to make them
weatherproof for use outdoors and such systems have limited
loadbearing capacities and cannot be used as structural
members.

25

It is also known to use an array of CRT, plasma or LCD
screens covered by thick glass sheets produce a large
display. However, the size is still limited and the overall
image produced is disrupted by the relatively thick edges to
30 the individual TV screens.

The present invention provides an assembly for covering
a visual display means which has an array of pixels, the

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assembly comprising an array of cells with reflective walls and an opening at each end, and a transparent cover sheet adjacent the open end of the cells on one side of the array, wherein the array is dimensioned such that in use each cell
5 is aligned with one pixel of the visual display means.

Preferably, the cells are contiguous and may be in the form of open ended tubes. In a preferred embodiment, the cells are formed from a honeycomb mesh of adjacent hexagonal
10 cells. Alternatively, the cells may be formed by a mesh with substantially square apertures. In a further alternative, each cell may comprise a parabolic reflector with an opening in the centre of the base for alignment with a pixel of the visual display means. In a further
15 alternative, each cell may comprise a light guide.

The walls of the cells may be provided with a surface treatment to increase reflectivity.

20 Additionally, a lens may be provided in each cell to capture substantially all of the light from the pixel.

The cover sheet preferably comprises glass or plastic. The assembly may also comprise a bottom sheet to create a
25 load bearing structure and may also provide a weather proofing capability to protect the visual display means.

To improve the optical performance, the cover sheet may be moulded to form a lens aligned with each cell of the
30 array. The cover sheet may also have a surface treatment applied to improve the optical characteristics.

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Further option to improve the optical performance is to include lens means between the array of cells and the cover sheet, aligned with the walls of the cells, to allow diffusion of light between adjacent cells. The lens means
5 may be in the form of adhesive used between the cells and the cover sheet.

The present invention also provides a visual display system comprising an assembly as described above secured to
10 a visual display means having an array of pixels, such that the array of cells is sandwiched between the cover sheet and the visual display means.

In another aspect, the present invention provides a
15 digital visual display system comprising a plurality of discrete light sources arranged in a plurality of rows, wherein the light sources in each row are offset with respect to the light sources in each adjacent row.

20 The invention will now be described in detail, by way of example only, with reference to the accompanying drawings in which:

Figure 1 is a schematic cross sectional view of part of a
25 first embodiment of the present invention in combination with a visual display means, along the line A-A in Figure 2;

Figure 2 is a schematic plan view of part of the first
embodiment shown in Figure 1;

30

Figure 3 is a schematic plan view of part of a second embodiment of the present invention;

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Figure 4 is a schematic plan view of part of a third embodiment of the present invention;

5 Figure 5 is a schematic plan view of part of a fifth embodiment of the present invention;

Figure 6 is a schematic cross sectional view through part of a fifth embodiment of the present invention; and

10

Figure 7 is a schematic cross sectional view of a further feature of the invention, applicable to all of the embodiments.

15 Figure 1 is a cross section through a first embodiment of the present invention in combination with a visual display means. The visual display means 10 is of the dot-matrix (or digital) type, that is it comprises an array of pixels 12 each of which is formed by a light source such as
20 an LED or the end of an optical fibre. The pixels 12 are mounted on a backing element 14 as is well known in the art.

The assembly 16 of the present invention comprises an array of cells 18 adjacent a transparent cover sheet 20.
25 The walls 22 of the cells 18 are formed by a honeycomb mesh creating contiguous hexagonal cells as best seen in the plan view of Figure 2. The cells 18 are thus open at each end. The honeycomb mesh is typically formed of a material such as aluminium, thus making the walls 22 of the cells 18
30 reflective.

- 5 -

The array of cells 18 is dimensioned so that the assembly can be fitted over the visual display means 10 with each pixel 12 aligned with the centre of one cell 18. Thus, light from each pixel 12 passes through a cell 18 and can be observed through the transparent top sheet 20 by an observer 24. Reflection from the walls 22 of the cells 18 helps to optimise the amount of light transmitted through the cells 18, thereby enhancing the brightness of the image seen by the observer 24. The walls 22 may have a surface treatment to improve their reflectivity. Additionally, lenses (not shown) may be incorporated into each cell 18 to capture substantially all of the light from each pixel 12.

Employing the assembly 16 of the present invention in combination with a visual display means 10 provides a number of benefits. First, in terms of optical performance, internal reflection within each cell 18 means that the cells 18 are flooded with light. This in turn means the image seen by the observer 24 comprises blocks of solid colour rather than dots of colour on a black background.

In addition, the viewing angle and viewing distance ranges are increased. Thus, an observer may view the display from a greater range of angles and from a greater range of distances and still see a coherent and legible image.

A further advantage is that the top sheet 20 may be designed to provide structural performance, when combined with a bottom perforated sheet, to the whole display unit, i.e. it may be a load bearing element, allowing the unit to be used to create or form part of a floor or wall structure.

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The top sheet 20 may also provide a weatherproofing function, allowing the display system to be used externally without further modification to the visual display means 10
5 itself.

The top sheet 20 may also be adapted to further enhance the optical performance by means of surface treatments and/or it may be moulded to form lenses (not shown) aligned
10 with each cell 18 of the array to improve the light output.

The cells 18 need not be hexagonal cells of a honeycomb structure as illustrated in Figures 1 and 2. The cells 18 may instead be formed of cylindrical tubes 26, packed
15 together as illustrated in Figure 3. Alternatively, a mesh 28 with substantially square apertures could be used as shown in Figure 4. Another arrangement is an array of equilateral triangles as seen in Figure 5. Another option is for each cell 18 to be in the form of a parabolic
20 reflector as seen in Figure 6, having an opening in the centre of the base of each parabola to receive the pixel 12.

In some circumstances it is desirable to have some diffusion of light between adjacent pixels. This enables
25 the improved rendering of images which have smooth edged forms or soft colour graduations. In order to allow for some diffusion between adjacent pixels, one option is to provide a form of lens (30) on the top of the walls 22 of the cells 18, extending between the walls 22 and the cover
30 sheet 20. This is illustrated in Figure 7. This network of lenses may be created as a separate part to be included in the assembly or may be formed by using a liquid adhesive,

- 7 -

which sets into a light transmitting bead between the cells 18 and the cover sheet 20. This arrangement may be incorporated in any of the embodiments described.

5 A further possibility is to form each cell 18 as a light guide such as a solid glass or plastic element with a plane face at each end, which allows substantially all the incident light to pass through without reflection, constituting the "open ends" of the cell. The side walls of
10 the light guide which join these end faces, however, provide for substantially total internal reflection so that all the light entering the light guide is transmitted through it and out of the opposing end face.

15 It will be apparent from these examples of cells 18 are not exhaustive and other possibilities exist.

As described above, the arrangement of pixels 12 and the shape and arrangement of the overlying cells 18 can take
20 a variety of forms. In particular, the pixels 12 may be arranged in a square grid as shown in Figures 4 and 5 in which the pixels are in rows with the pixels in each row being aligned with the pixels in each adjacent row. Alternatively, the pixels 12 may be in an offset arrangement
25 with the pixels in each row being offset with respect to the pixels in each adjacent row as in Figures 2 and 3. In some applications, this offset arrangement is preferred since each pixel 12 has a greater number of equidistant neighbouring pixels 12. In the arrangements of Figures 2
30 and 3, each pixel 12 will be equidistant from 6 neighbouring pixels 12. However, with the arrangement of Figures 4 and 5 each pixel has only four equidistant neighbours closest to

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it. The offset arrangement, with each pixel having a greater number of equidistant neighbours, allows improved mapping of images onto the display and this results in images of better effective resolution to the observer.

5

Thus, the present invention makes it possible to provide large visual display systems with excellent optical performance which are useable both internally and externally and are capable of bearing loads and forming structural members. It will be apparent that a number of variations and modifications to the precise details described herein are possible, without departing from the scope of the invention are set out in the claims.

15

CLAIMS

1. An assembly for covering a visual display means having an array of pixels, the assembly comprising an array of
5 cells with reflective walls and an opening at each end, and a transparent cover sheet adjacent the open ends of the cells on one side of the array, wherein the array is dimensioned such that in use each cell is aligned with one pixel of the visual display means.
- 10 2. An assembly as claimed in claim 1, wherein the cells are contiguous.
3. An assembly as claimed in claim 1 or claim 2, wherein
15 each cell comprises a tube open at each end.
4. An assembly as claimed in any preceding claim, wherein the array comprises a honeycomb mesh creating adjacent hexagonal cells.
- 20 5. An assembly as claimed in any of claims 1 to 3 wherein the array comprises a mesh with substantially square apertures.
- 25 6. An assembly as claimed in any of claims 1 to 3, wherein each cell comprises a parabolic reflector having an opening in the centre of the base for alignment with pixel.
- 30 7. An assembly as claimed in any of claims 1 to 3, wherein each cell comprises a light guide.

- 10 -

8. An assembly as claimed in any preceding claim wherein the walls of the cells are provided with a surface treatment to increase their reflectivity.

5 9. An assembly as claimed in any preceding claim further comprising a lens in each cell.

10. An assembly as claimed in any preceding claim, wherein the cover sheet comprises glass or plastic.

10

11. An assembly as claimed in any preceding claim, further comprising a bottom sheet to create a load bearing element.

12. An assembly as claimed in any preceding claim, wherein
15 the cover sheet provides weather proofing to the visual display means.

13. An assembly as claimed in any preceding claim, wherein the cover sheet is shaped to form a lens aligned with each
20 cell of the array.

14. An assembly as claimed in any preceding claim, wherein the cover sheet is provided with a surface treatment to improve the optical performance.

25

15. Assembly as claimed in any preceding claim, further comprising lens means arranged between the array of cells and the cover sheet, aligned with the walls of the cells, operable to diffuse light between adjacent cells.

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16. An assembly as claimed in claim 15, wherein the lens means is provided by adhesive between the cells and the cover sheet.

5 17. A visual display system, comprising an assembly as claimed in any preceding claim secured to a visual display means having an array of pixels, such that the array of cells is sandwiched between the cover sheet and the visual display means.

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18. A digital visual display system comprising a plurality of discrete light sources arranged in a plurality of rows, wherein the light sources in each row are offset with respect to the light source in each adjacent row.

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FIG. 1

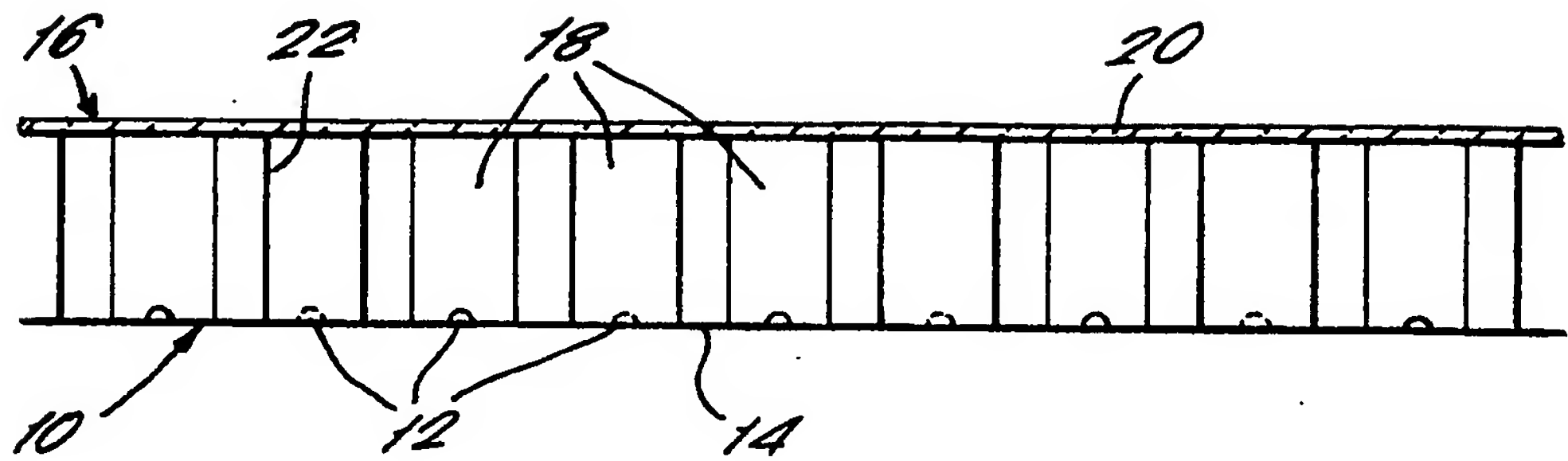


FIG. 2

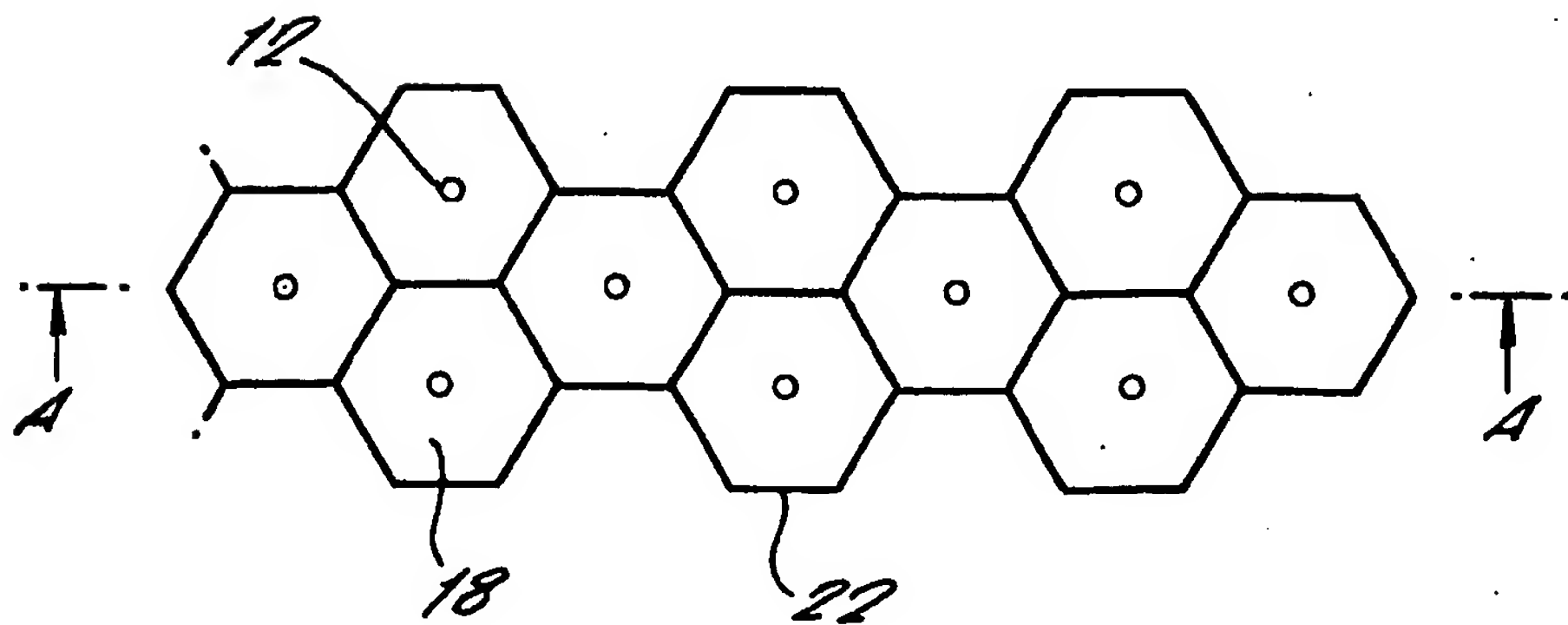


FIG. 3.

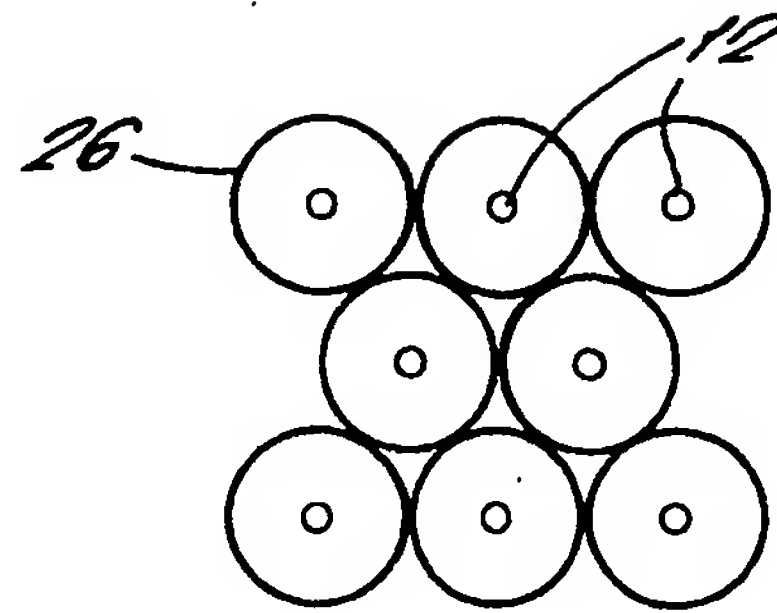


FIG. 4.

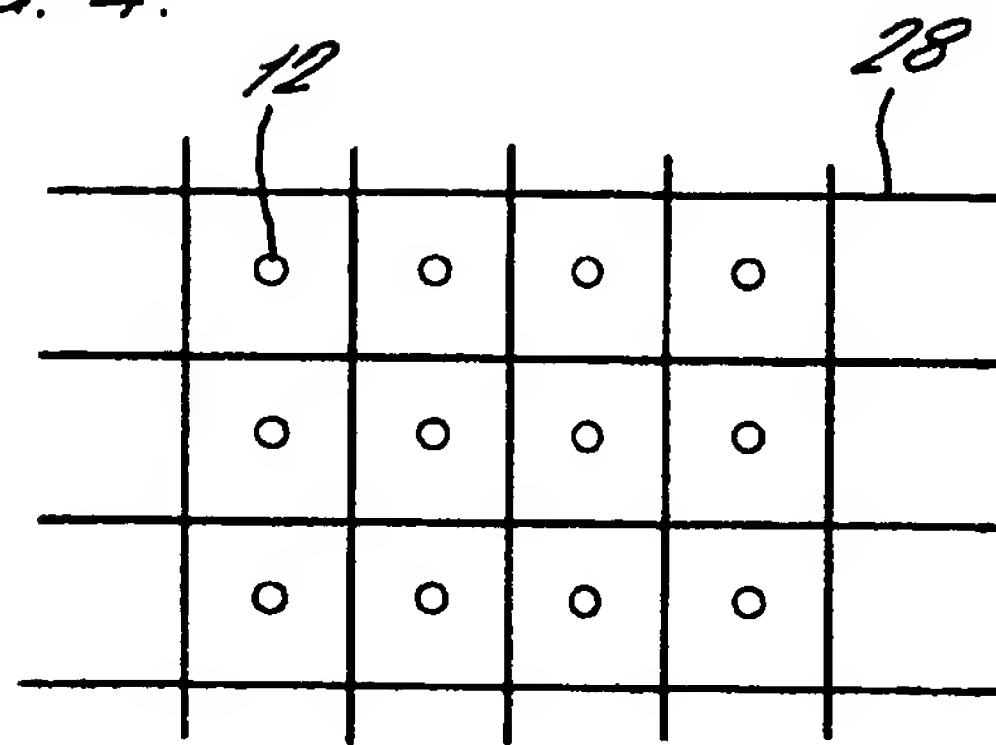


FIG. 6.

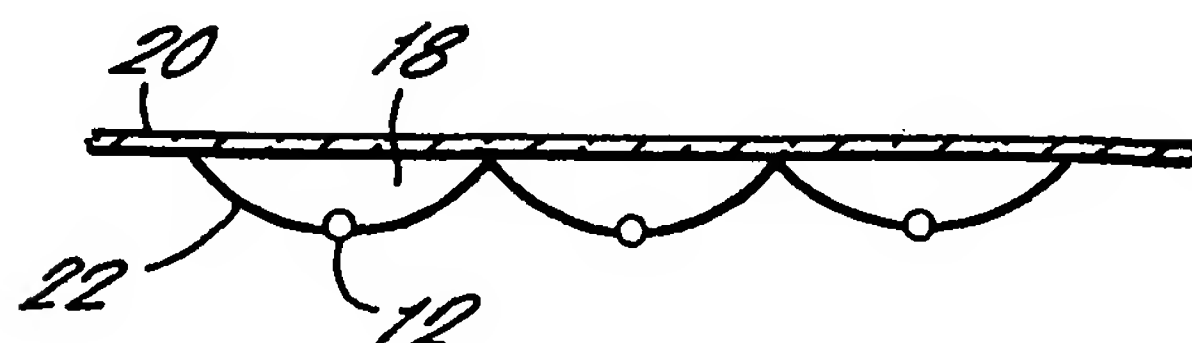


FIG. 5.

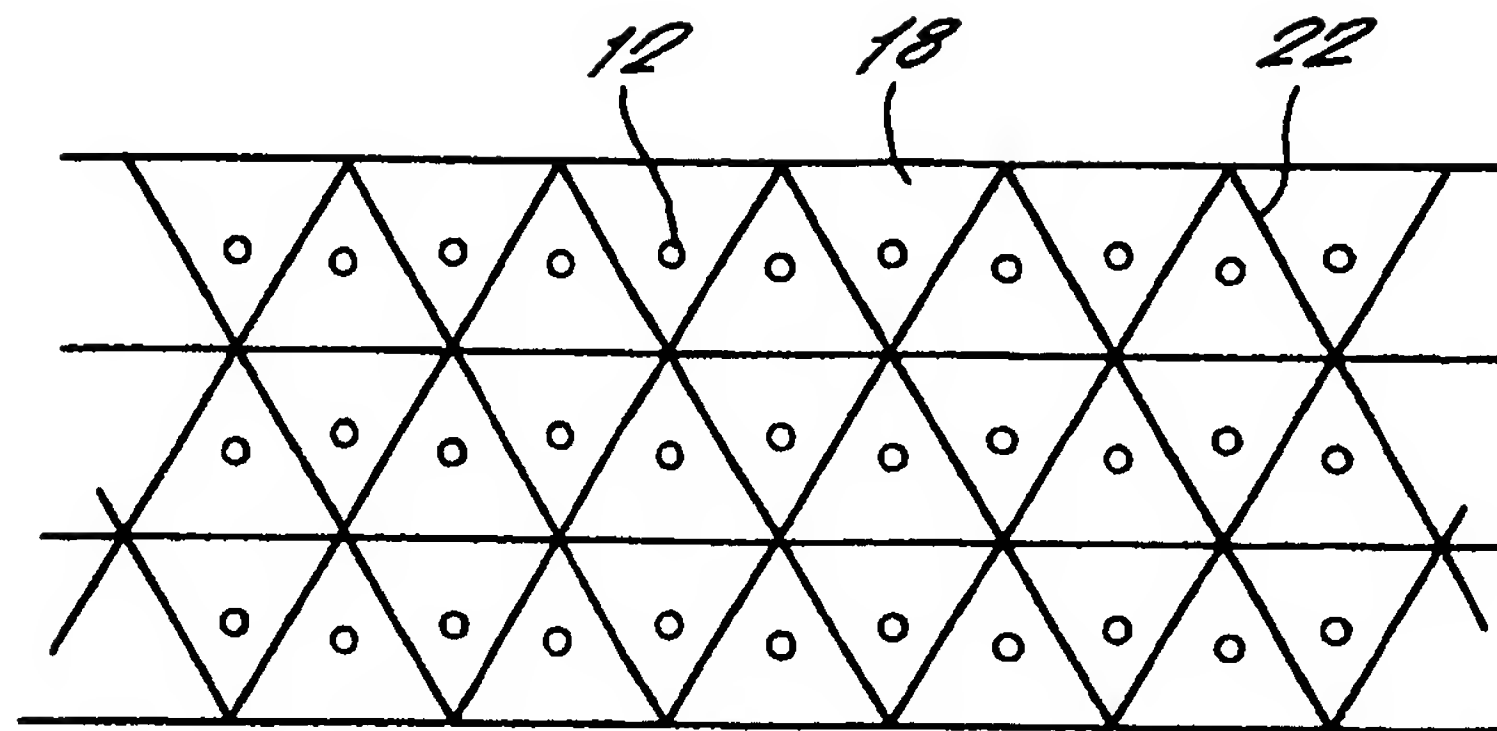
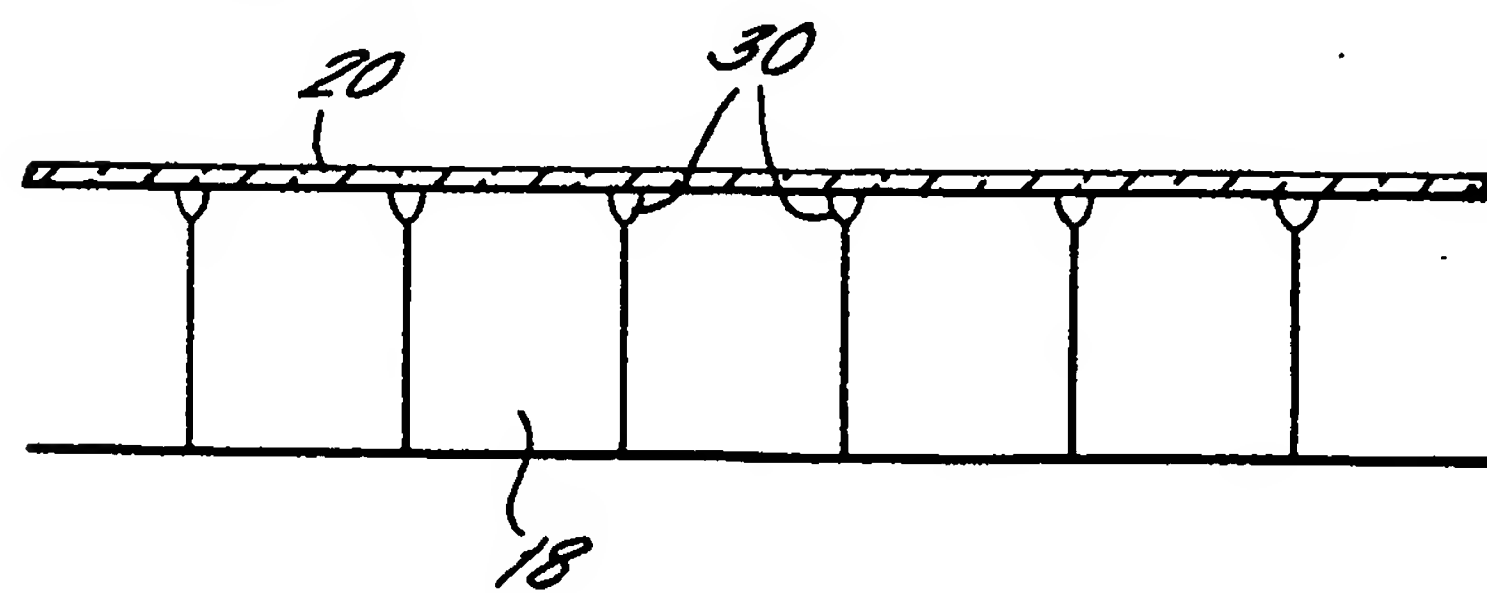


FIG. 7.



INTERNATIONAL SEARCH REPORT

PCT/GB 03/04770

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 G09F9/305

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched, (classification system followed by classification symbols)
IPC 7 G09F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 100 06 164 A (HEIDELBERGER DRUCKMASCH AG) 21 September 2000 (2000-09-21)	1-3, 8,
Y	column 3, line 9 - line 26; figures	10, 17
Y	WO 89 08304 A (CASSEL SMITH LIMITED) 8 September 1989 (1989-09-08)	4, 6, 7, 18
Y	abstract; figures	4, 18
Y	US 4 254 453 A (HAMBY MICHAEL V. ET AL) 3 March 1981 (1981-03-03)	6
Y	abstract; figures	
Y	GB 1 491 142 A (JENAER GLASWERK SCHOTT & GEN) 9 November 1977 (1977-11-09)	7
	figures	

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☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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Date of the actual completion of the international search

9 February 2004

Date of mailing of the international search report

19/02/2004

Name and mailing address of the ISA

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INTERNATIONAL SEARCH REPORT

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

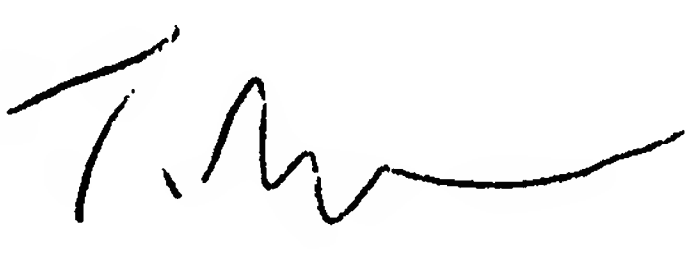
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 95 18435 A (ROSENITSCH HARALD) 16 October 1996 (1996-10-16) the whole document ---	1-3, 5, 6, 9, 10, 12, 13, 17, 18
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US 4603496	A	05-08-1986	NONE		

VIII-4-1	<p>Declaration: Inventorship (only for the purposes of the designation of the United States of America) Declaration of inventorship (Rules 4.17(iv) and 51bis.1(a)(iv)) for the purposes of the designation of the United States of America:</p>	<p>I hereby declare that I believe I am the original, first and sole (if only one inventor is listed below) or joint (if more than one inventor is listed below) inventor of the subject matter which is claimed and for which a patent is sought.</p> <p>This declaration is directed to the international application of which it forms a part (if filing declaration with application).</p> <p>I hereby declare that my residence, mailing address, and citizenship are as stated next to my name.</p> <p>I hereby state that I have reviewed and understand the contents of the above-identified international application, including the claims of said application. I have identified in the request of said application, in compliance with PCT Rule 4.10, any claim to foreign priority, and I have identified below, under the heading "Prior Applications," by application number, country or Member of the World Trade Organization, day, month and year of filing, any application for a patent or inventor's certificate filed in a country other than the United States of America, including any PCT international application designating at least one country other than the United States of America, having a filing date before that of the application on which foreign priority is claimed.</p>
VIII-4-1 -1	Prior applications:	0225773.1, GB, 05 November 2002 (05.11.2002)

		<p>I hereby acknowledge the duty to disclose information that is known by me to be material to patentability as defined by 37 C.F.R. § 1.56, including for continuation-in-part applications, material information which became available between the filing date of the prior application and the PCT international filing date of the continuation-in-part application.</p> <p>I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.</p>
VIII-4-1 -1-1	Name:	BARKER, Tom
VIII-4-1 -1-2	Residence: (city and either US State, if applicable, or country)	London, United Kingdom
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VIII-4-1 -1-4	Citizenship:	
VIII-4-1 -1-5	Inventor's Signature: (if not contained in the request, or if declaration is corrected or added under Rule 26ter after the filing of the international application. The signature must be that of the inventor, not that of the agent)	
VIII-4-1 -1-6	Date: (of signature which is not contained in the request, or of the declaration that is corrected or added under Rule 26ter after the filing of the international application)	23/11/03